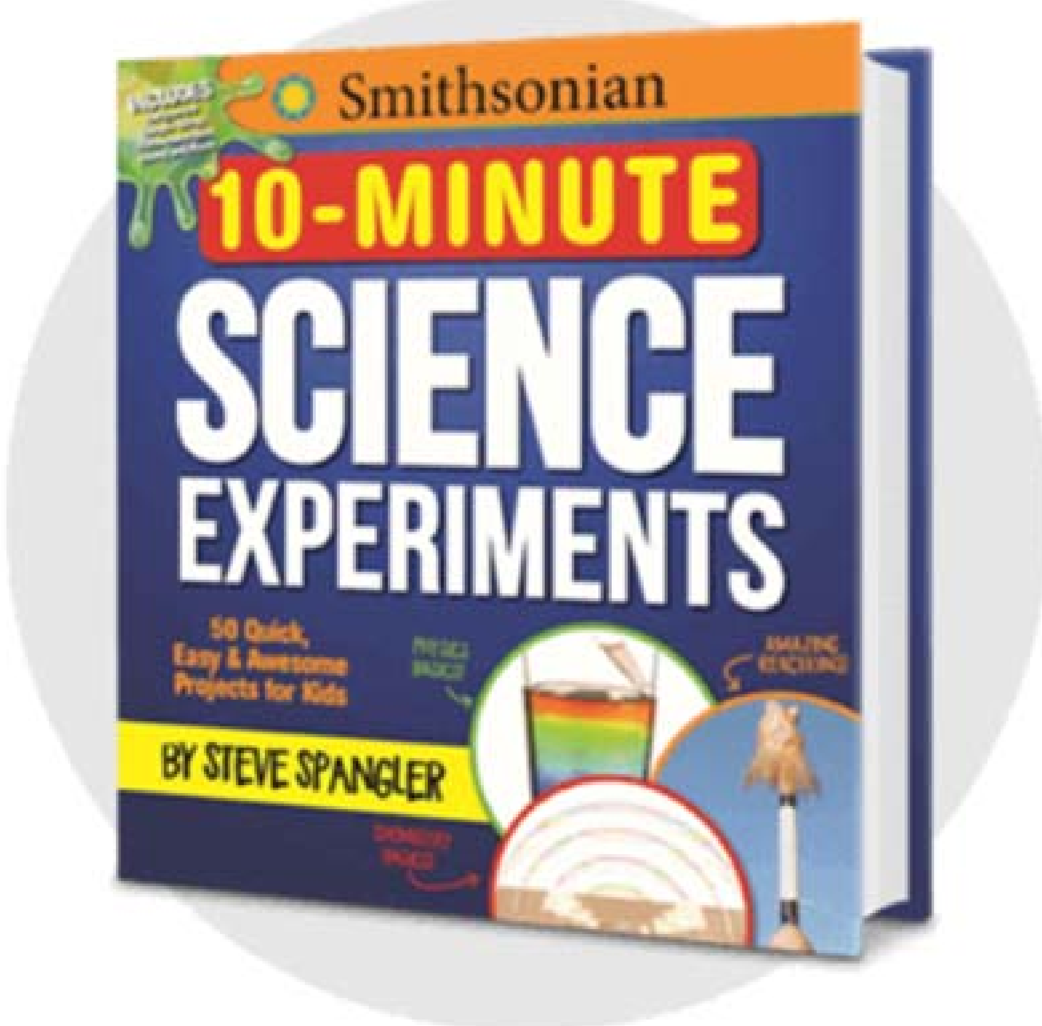

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Do ~~Don't~~ Try This at Home...

LET'S CUT TO THE CHASE AND BE HONEST—science experiments have changed over the years. OK, maybe the experiments haven't changed, but the way they're presented has. It seems all of today's science experiments come with a warning that reads, "Don't try this at home!" This is especially true when someone breaks out the vinegar and baking soda or anything else that might fizz, bubble, pop or get someone excited about learning.

What's the first thought that pops into your head when you hear, "Don't try this at home?" That's right... "I must do everything possible to try this at home!" The warning becomes a challenge for every young scientist who hears it.

Here's the good news: This book is filled with great science activities, demonstrations and science fair project ideas that are easy to do and guaranteed to get your creative juices flowing. And all of them can be done using materials you most likely have around the house! Don't be fooled by the list of simple materials required for many of the experiments—vinegar, eggs, plastic bags, salt, soap, etc.—even though they're basic ingredients, the "wow" factor of the activities is huge. At the end of each experiment, you'll learn the real science behind all of the "gee-whiz." You'll learn not only the "how" but the "why." And then something strange will happen—you'll start to ask your own questions and create your own experiments. Don't be surprised if a little voice in your head starts to ask things like, "What would happen if I changed this or tried that?" Curiosity will get the best of you and you'll find yourself doing the experiment again and again with your own changes and ideas.

And no matter what else you do, remember to make science fun!

-Steve Spangler

Floating Ping-Pong Ball

Find out what's "up" with Bernoulli's Principle.

MATERIALS

- Adult supervision

- Tape

- Large nail

- Utility blade

- Bendy straw

- Ping-pong ball

- Hammer

- 1-liter bottle with cap

LET'S EXPERIMENT

1 Near the top of a 1-liter bottle, just before the sides start to curve inward, wrap a piece of tape. Try to wrap the tape as straight as possible around the entire circumference of the bottle.

2 With adult help, use the tape as a guide to cut the top of the bottle off with the box cutter. Again, try to make your cut as straight as possible.

3 Find a work bench or similar surface and ask an adult for help. Place the bottle cap, open side down, onto the work bench. Center a large nail on the top of the bottle cap and use a hammer to punch a hole in the cap. Pull the nail out of the bottle cap and you should have a nice, round hole.

4 Test the bottle cap to see if a bendy straw will fit snugly in the hole you've created.

If the hole is too small, find a larger nail and widen the hole. If the hole is too large, wrap tape around the short end of the straw until it fits.

5 Once you have right fit, screw the cap onto the top of the bottle. Place the short end of the bendy straw through the hole.

6 Start blowing into the straw (the end opposite the bottle) and place the ping-pong ball over the stream of air. Observe what happens!

DID YOU KNOW?

Daniel Bernoulli published his "flying" principle in 1738, but the Wright Brothers did not make their first successful plane flights until 1903.

HOW DOES IT WORK?

This is an example of Bernoulli's Principle, the same principle that allows heavier-than-air objects, like airplanes, to fly. Daniel Bernoulli, an 18th century Swiss mathematician, found that the faster air flows over the surface of something, the less the air pushes on that surface. That means that the air pressure on the object is lower than average.

The air from the straw produces the levitating ball phenomenon using Bernoulli's Principle. The fast air that you are blowing around the sides of the ball is at a lower pressure than the surrounding, stationary air. If you look closely, you'll see that the ball wobbles while it is levitating in midair. The ball is attempting to leave the area of low pressure, but the higher air pressure surrounding it forces it back into the low pressure area.

Gobstopper Candy Science

What happens when you dissolve these colorful candies in water?

MATERIALS

- White plate

- Room-temperature water

- Everlasting Gobstopper® candies

LET'S EXPERIMENT

1 Separate the Gobstoppers according to color and place three of each against the outside rim of a plate. They should be about equal distances from each other.

DID YOU KNOW?

This candy gets its name from British slang. In the U.K. and Ireland, “gob” means mouth.

2 Gently pour in enough room-temperature water to cover the bottom half of the candy.

3 Observe what happens over the next 5–10 minutes. What do you notice about the colors?

HOW DOES IT WORK?

Each Gobstopper is made up of four colors (and flavors), with a thin layer of wax between each color. Because of this, two important things happen in this experiment. First, thanks to the wax, the Gobstopper colors don’t initially mix in the water. Instead, they run into each other and stop. Second, because of the multiple layers, the colors change during the dissolving process.

TAKE IT FURTHER

Repeat this experiment using hot water. Do you think the results will be the same?

Homemade Geyser Tube

Build your own ignition device for this popular (and messy) experiment.

MATERIALS

- Safety glasses

- Roll of Mentos®

- 2-liter bottle of Diet Coke®

- Construction paper

- Toothpicks

- Electrical or duct tape

LET'S EXPERIMENT

1 **Use the roll of Mentos® to roll the construction paper into a cylinder shape around the candy. You want the paper to be snug while still allowing room for the candy to be removed from it. Slide the candy out of the paper tube.**

2 Tape both ends of the tube to securely hold the shape and size of the rolled paper. You may want to tape the edge of the paper too. (Leaving the Mentos® in the tube may make taping easier. Just remove the candy for the next step.)

3 Place one end of the paper tube into the mouth of the diet soda bottle. Make sure the bottom end of the tube is straight and smooth along its length. Also make sure the soda is still carbonated and hasn't gone flat.

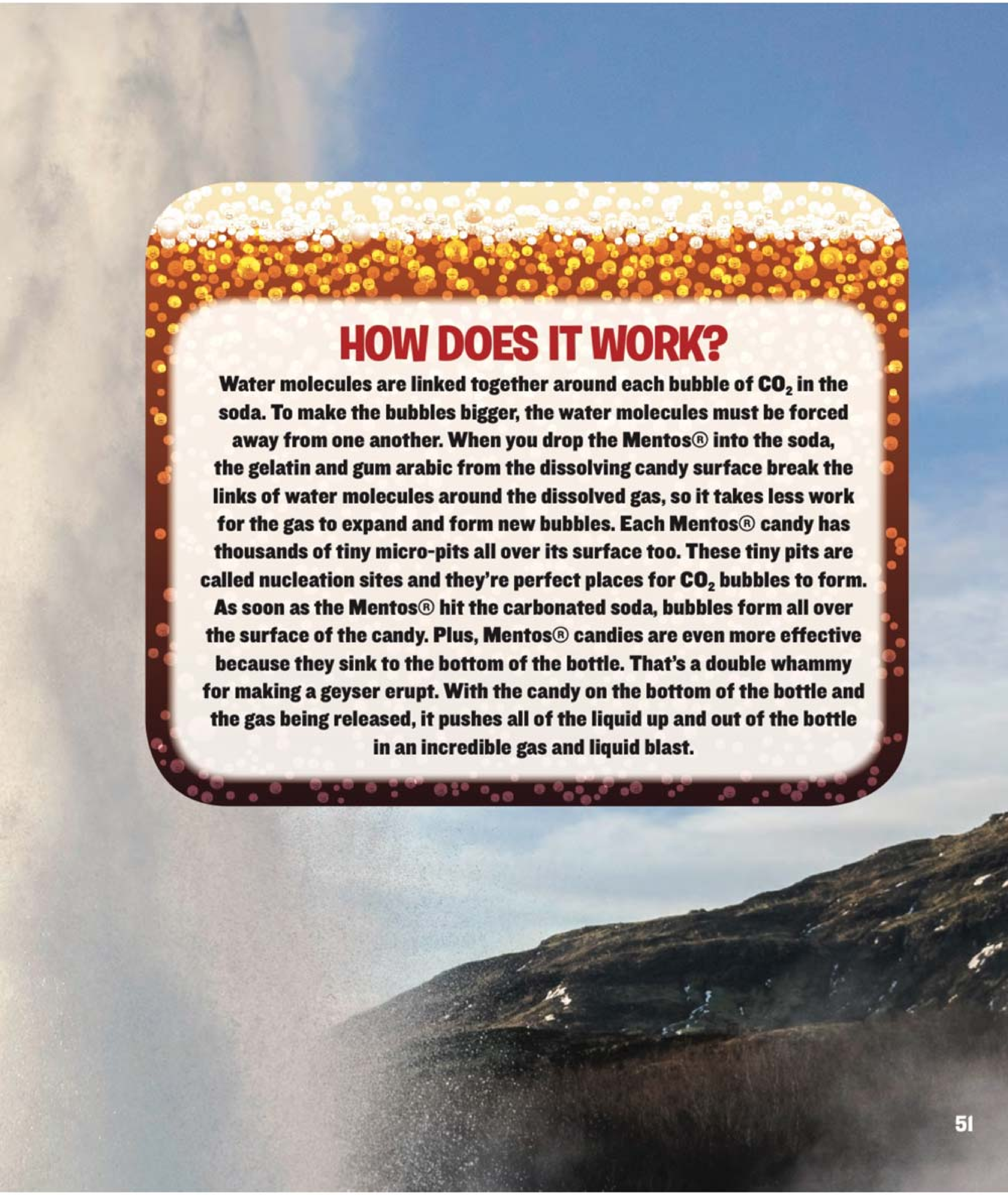
4 Hold the tube firmly in place with tape around the bottle opening.

5 Just above the tape by the opening, insert a toothpick straight through the paper. The toothpick needs to be centered in the tube and pierce both sides of the tube. Avoid making these two holes too large. The toothpick is the firing pin for the eruption.

6 GO OUTSIDE! Don't cause eruptions indoors. Drop 5–7 Mentos® into the top opening of the tube. When you're all set, slide out the toothpick and stand back! In a few seconds, the geyser will erupt.

DID YOU KNOW?

The proper word for an individual disc of the candy is dragee, pronounced "drah-jay." This comes from the French word dragée, meaning a sugar-coated pill.



HOW DOES IT WORK?

Water molecules are linked together around each bubble of CO_2 in the soda. To make the bubbles bigger, the water molecules must be forced away from one another. When you drop the Mentos® into the soda, the gelatin and gum arabic from the dissolving candy surface break the links of water molecules around the dissolved gas, so it takes less work for the gas to expand and form new bubbles. Each Mentos® candy has thousands of tiny micro-pits all over its surface too. These tiny pits are called nucleation sites and they're perfect places for CO_2 bubbles to form. As soon as the Mentos® hit the carbonated soda, bubbles form all over the surface of the candy. Plus, Mentos® candies are even more effective because they sink to the bottom of the bottle. That's a double whammy for making a geyser erupt. With the candy on the bottom of the bottle and the gas being released, it pushes all of the liquid up and out of the bottle in an incredible gas and liquid blast.

Soap Soufflé

Blow up a bar of Ivory® soap in the microwave.

MATERIALS

• Bar of Ivory® soap (must use Ivory® brand soap)

• Various bars of other soap brands

• Deep bowl (or plastic tub) of water

• Microwave

• Knife

LET'S EXPERIMENT

1 The first part of this experiment is designed to prove whether its claim to fame is true: Does Ivory® soap really float? Fill the bowl with water and drop in a brand-new bar of Ivory® to see for yourself.

2 Maybe all bars of soap float? If you have other brands of soap, try the float or sink test. You'll probably discover that all of the bars of soap sink except for the Ivory® brand soap. Why?

3 Remove the Ivory® from the water and break it in half. Make some observations about the shapes and textures inside the bar.

4 **Use the knife to carefully cut the bar of Ivory® into four equal pieces. Place the pieces of soap on a dinner plate, then place the whole thing in the center of the microwave, after asking permission from an adult.**

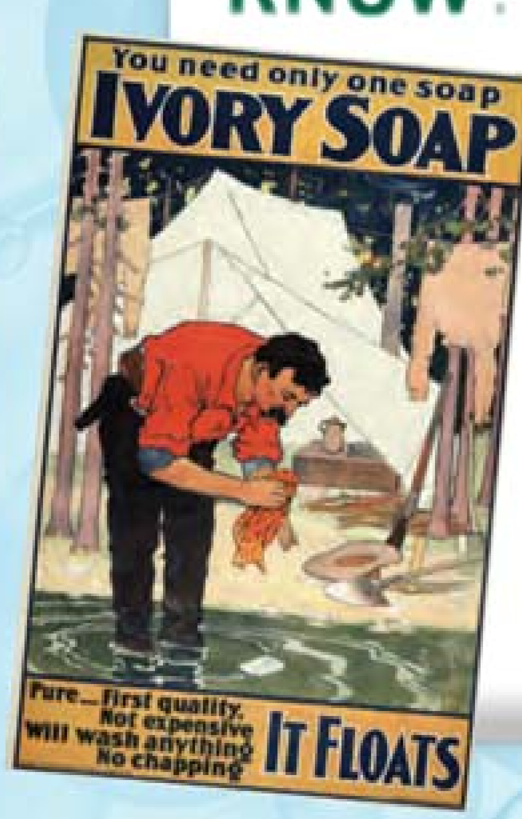
5 **Cook the bar of soap on high for 1 minute. Don't take your eyes off the bar of soap—be sure to watch closely and make observations of what's happening. Be careful not to overcook your soap soufflé!**

6 **Allow the soap to cool for a minute or so before touching it. It's puffy but rigid! Don't waste the soap. It still works perfectly with a slightly different shape and size.**

HOW DOES IT WORK?

Ivory® soap floats because air is whipped into the soap during the manufacturing process. If you break the bar of soap in half with your hands and look closely at the edge of the bar, you'll see tiny pockets of air. Those air bubbles in the soap contain water molecules. The expanding effect is caused when the water is heated by the microwave. The water vaporizes and the heat causes the trapped air to expand. Likewise, the heat causes the soap itself to soften and become pliable.

DID YOU KNOW?



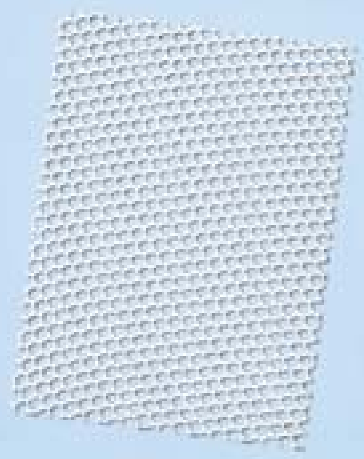
The air-filled soap is believed to have been made by accident in the late 19th century by a Procter & Gamble employee who forgot to turn off the mixing machine. This caused so much air to be whipped into the soap that the batch nearly doubled in size. When the soap was formed into bars, they floated in water!

Mysterious Water Suspension

It's not magic–it's science!

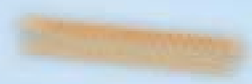
MATERIALS

- Empty clear soda bottle



- Plastic mesh screen

- Rubber band



- Toothpicks

- Pitcher of water

LET'S EXPERIMENT

1 Place the plastic screen mesh over the opening of the soda bottle. Secure it in place with a rubber band, then pour in water to fill the bottle.

2 Hold your hand over the mesh, then flip the whole bottle upside-down. Remove your hand. What happens? Is that what you expected?

3 Keeping the bottle vertical, push one toothpick through the mesh. What happens? Does any of the water run out?

4 Hold the bottle over the pitcher and tilt it until the water flows out. How do you think that happened?

HOW DOES IT WORK?

How does the water stay in the jar when your hand is removed? The answer is surface tension. The surface of a liquid behaves as if it has a thin membrane stretched over it. A force called cohesion, which is the attraction of similar molecules to each other, causes this effect. The water stays in the jar even though your hand is removed because the molecules of water are joined together (through cohesion) to form a thin membrane between each tiny opening in the screen. If you tip the jar at all, air will come into the jar and break the seal, causing the water to pour out.

You can even push a toothpick in without completely the surface tension, though you may have noticed a small drip of water coming out—it had to in order to make room for the toothpick.

TAKE IT FURTHER

Experiment with different screens. How does the size of the mesh affect the surface tension of the water?

DID YOU KNOW?

Surface tension is the reason why bugs such as water striders can walk on water.

Sugar Rainbow

Understanding density has never been easier–or more colorful!

MATERIALS

- 6 tall, clear glasses (See NOTE in Step 1)
- Water (See NOTE in Step 3)
- Small dish or sink

- Turkey Baster

- Clear drinking straw

- Coloring tablets or food coloring
- Granulated sugar (You'll have great results with Imperial® Sugar or Dixie Crystals®.)
- Measuring spoons

LET'S EXPERIMENT

1 Fill each of the six glasses with water.
NOTE: The glasses need to be stable and about as deep as the straw is long. If you have shorter glasses, cut the straw to their length.

2 Use coloring tablets or food coloring to dye the water a different, bright color in each glass. You may need to mix the food coloring to make enough colors. Stir each glass completely.

3 The first of the six glasses will be just colored water with no sugar. The second color receives 1 rounded teaspoon of sugar. The third color receives 2 rounded teaspoons of sugar. The fourth gets 3 teaspoons and so on to 5 teaspoons of sugar in the last glass. Stir the solution in each glass until the sugar is completely dissolved.

NOTE: Using warm or room-temperature water will speed up this process.

Sugar Rainbow

4 Grab the straw and, if you haven't already, remove the wrapper. Hold the straw near one end, wrapping four fingers around the straw and placing your thumb over the straw's top opening.

5 To make your Sugar Rainbow, lift your thumb off the opening, dunk the lower end of the straw about 1 inch (3 cm) into the plain water. Cap the straw firmly with your thumb and lift it out of the water.

6 Dip the straw into the 1 teaspoon solution. This time, go twice as deep as you did into the first glass. With the straw in the liquid, lift your thumb but quickly replace it. Lift the straw and you'll have the first and second colored solutions in a stack inside the straw.

7 Continue the dipping process until you have all six colored solutions inside the straw. It's a density column of sugar water—a Sugar Rainbow!

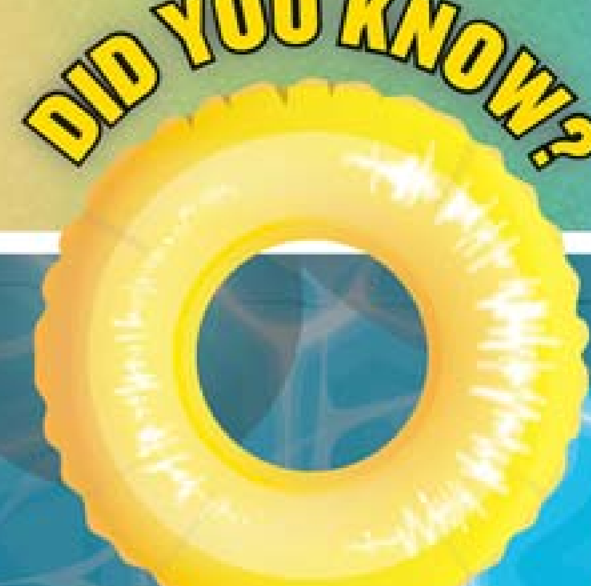
8 To make an even bigger rainbow, use a turkey baster as a replacement for the straw to slowly layer the colored sugar solutions into a glass.

9 Draw in the liquid with the most sugar and add it to the glass.

10 Rinse the baster in fresh water. Draw in the liquid with the second-most amount of sugar. Hold the tip of the baster against the side of the container, close to the surface of the liquid already in the glass. Squeeze the baster gently so the water flows slowly down the side and then onto the previous layer.

11 Layer the rest of the sugar solutions in the same way. This can be hard to do but it's worth the effort when you finish. Make sure to take pictures!

DENSITY
is the measurement of how much "stuff" is packed into a measured space. Nearly every substance and material imaginable has a different density.



While humans will (sort of) float in an ocean, they float better in salty bodies of water like Utah's Great Salt Lake. It's so salty that it has a very high density, making it nearly impossible for humans to sink!

HOW DOES IT WORK?

By increasing the amount of sugar in the solution but keeping the amount of water constant, you create solutions that have increasing densities. The more sugar that's mixed into a measured amount of water, the higher the density of the mixture. As the Sugar Rainbow reveals, a solution with a low density stacks on top of a mixture with a high density.

STEVE SPANGLER—known by fans worldwide for his wildly funny, unconventional and engaging science demonstrations on stage, television and other venues—first came to fame in 2005 with his Mentos Diet Coke Experiment in which he taught millions via YouTube how to turn an ordinary bottle of soda into an erupting geyser of fun. Today, Steve's catalog of videos featured on YouTube have more than 350 million views, and his books and online experiments are widely used by parents and educators to increase student engagement and inspire young scientists to learn more about STEM-based careers.

Spangler is a bestselling author, educator and Emmy award-winning television host who finds the most creative ways to make science fun. With more than 1,300 television appearances and multiple Emmy awards to his credit, Steve is also a regular guest on *The Ellen DeGeneres Show,* where she dubbed him "America's Science Teacher." He hosts his own nationally syndicated television series called *DIY Sci*, where viewers learn how to use do-it-yourself experiments to amaze friends. Spangler was inducted into the National Speaker Hall of Fame in 2010 and he holds a Guinness World Record for conducting the world's largest science experiment in 2009.

To learn more, visit *SteveSpangler.com.*